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All Dried Out: How Responses to Drought Make Droughts Worse

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ALL DRIED OUT: HOW RESPONSES TO DROUGHT MAKE DROUGHTS WORSE

Vanessa Casado Pérez*

Water usage is governed through a variety of mechanisms, including government administration and market tools. From 2006 to 2008, the region of Barcelona, a water scarce area, suffered a drought comparable to the one faced today by the U.S. West. This article surveys a variety of techniques that were and could have been used to address these scarcity challenges. Spanish water regulations established water markets in 1999, but neither the design nor its implementation was optimal. In addition to the design and implementation flaws, the response to the 2007-2008 drought crisis showed how emergency measures highjacked water markets as a viable solution to water scarcity. Emergency responses bailed out urban voters while no structural solutions were adopted to make water use in the agricultural sector more efficient. Thus, neither the urban suppliers nor the agricultural sector had incentives to participate in a water market, and the drought was managed using ad hoc solutions. The U.S. West can draw lessons to tackle the current and future droughts from Spain's responses to its water crisis.

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* Teaching Fellow – Lecturer, Stanford Law School, Environmental Law and Policy Program. I gratefully acknowledge the helpful comments of Albert Azagra, Lewis Kornhauser, David Kosar, Jacob Hale Russell, Karen Bradshaw Schulz, and Katrina M. Wyman, the participants in the NYU JSD forum, and thank the editors of Tulsa Law Review for their hard work.

I. INTRODUCTION

Water scarcity is a growing global issue. A vast literature surrounding water governance techniques to address scarcity focuses heavily on the potential of water markets.¹ Catalonia, Spain suffered from two consecutive droughts in the four-year period between 2004 and 2008.² Catalan towns and villages were subjected to water restrictions. Barcelona, the capital of Catalonia, was on the brink of severe domestic water restrictions on household usage. This article illustrates the inability of an administrative governance regime to deal with drought conditions through the novel case study of the 2007-2008 drought in Barcelona and its surroundings, an area which suffers from structural water scarcity. This drought crisis unveiled the instances where markets could be introduced and how the piecemeal response undertaken by Spanish and Catalan authorities exacerbated the scarcity problems going forward, since their policies undermined water markets.

Water market scholarship has offered not only theoretical accounts but also case studies, the majority of them grounded in the Western United States' prior appropriation systems.³ This article provides a novel overview of water regulation in Catalonia, Spain, with an emphasis on the administrative response during the 2007-2008 drought. By placing the market proposals in a specific case study of an administrative-centered water management system, this paper opens the door to the introduction of water markets in those jurisdictions where the right to use water is allocated by granting permits. Hence, it offers an

1. The free-market environmentalist position is framed in, among other sources, TERRY L. ANDERSON & PAMELA SNYDER, *WATER MARKETS: PRIMING THE INVISIBLE PUMP* 7 (Cato Institute 1997); *WATER MARKETING—THE NEXT GENERATION* 32 (Terry L. Anderson & Peter J. Hill eds., 1997). See also R. SMITH, *TRADING WATER: AN ECONOMIC AND LEGAL FRAMEWORK FOR WATER MARKETING* (The Council of State Policy and Planning Agencies 1988); James L. Huffman, *Water Marketing in Western Prior Appropriation States: A Model for the East*, 21 GA. ST. U. L. REV. 429 (2004); Mark W. Rosegrant & Hans P. Binswanger, *Markets in Tradable Water Rights: Potential for Efficiency Gains in Developing Country Water Resource Allocation*, 22 WORLD DEV. 1613 (1994); Mateen Thobani, *Tradable Property Rights to Water: How to Improve Water Use and Resolve Water Conflicts*, VIEWPOINT (The World Bank, Private Sector Dev. Dep't.), at 1 (Feb. 1995). For a more nuanced position, see for example, Robert Glennon, *The Quest for More Water: Why Markets Are Inevitable*, PERC REP., Sept. 2006, at 7, <http://www.perc.org/sites/default/files/sept06.pdf>. See also Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 TEX. L. REV. 1873 (2005); Joseph L. Sax, *Understanding Transfers: Community Rights and the Privatization of Water*, 14 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 33 (2008).

2. Pedro Brufao Curiel, *La Regulación jurídica de las sequías: Crítica a la regulación extraordinaria y urgente de un fenómeno natural y cíclico propio del clima*, 187 REVISTA DE ADMINISTRACIÓN PÚBLICA 199, 211 (2012).

3. There are several articles on specific water markets in the Western U.S. See, e.g., Bonnie G. Colby, Mark A. McGinnis & Ken A. Rait, *Mitigating Environmental Externalities Through Voluntary and Involuntary Water Reallocation: Nevada's Truckee-Carson River Basin*, 31 NAT. RESOURCES J. 757 (1991); Robert Glennon & Michael J. Pearce, *Transferring Mainstream Colorado River Water Rights: The Arizona Experience*, 49 ARIZ. L. REV. 235 (2007); Ellen Hanak & Caitlin Dyckman, *Counties Wrestling Control: Local Responses to California's Statewide Water Market*, 6 U. DENV. WATER L. REV. 490 (2003); Richard Howitt & Ellen Hanak, *Incremental Water Market Development: The California Water Sector 1985-2004*, 30 CAN. WATER RES. J. 73 (2005); Ronald A. Kaiser, *Texas Water Marketing in the Next Millennium: A Conceptual and Legal Analysis*, 27 TEX. TECH. L. REV. 181 (1996); Kevin M. O'Brien & Robert R. Gunning, *Water Marketing in California Revisited: The Legacy of the 1987-92 Drought*, 25 PAC. L.J. 1053 (1994); Brandon Winchester & Ereny Hadjigeorgalis, *An Institutional Framework for a Water Market in Elephant Butte Irrigation District*, 49 NAT. RES. J. 219 (2009). Chile, which has a very strong private rights framework, has also been the object of several case studies. See, e.g., ROBERT R. HEARNE, *Institutional and Organisational Arrangements for Water Markets in Chile*, in *MARKETS FOR WATER: POTENTIAL AND PERFORMANCE* 181 (K. W. Easter, M. W. Rosegrant & A. Dinar eds., 1998); Carl J. Bauer, *Bringing Water Markets Down to Earth: The Political Economy of Water Rights in Chile, 1976-95*, 25 WORLD DEV. 639 (1997); Carl J. Bauer, *Slippery Property Rights: Multiple Water Uses and the Neoliberal Model in Chile*, 38 NAT. RES. J. 109 (1998); Ereny Hadjigeorgalis, *Comerciendo con incertidumbre: los mercados de agua en la agricultura chilena* [Trading with Uncertainty: Water Markets in Chilean Agriculture], 41 CUADERNOS DE ECONOMÍA 3 (2004).

approximation of how water markets could work in those Eastern United States, where states have adopted models of regulated riparianism.⁴ Prior appropriation jurisdictions, which share many of the scarcity challenges Mediterranean regions are suffering, could also learn from Catalonia's experience. Most of these jurisdictions have adopted a permit system codifying the common law requirements and requiring users to apply before an administrative agency for a water right.

Part I describes the institutional system of water management in Catalonia. This is a necessary step in order to understand what measures could be taken to solve the mismatches between supply and demand, and more specifically, which gaps water markets could fill. Those mismatches and the status of water resources during the 2007-2008 drought are examined in Part II. Part III surveys the measures that were or could have been used to manage water scarcity in Catalonia—either by increasing supply or decreasing demand—and underscores the role that water markets could have played as mechanisms to help mitigate the effects of droughts and structural scarcity. The design and implementation of water markets in Catalonia is compared to the California experience, since water markets in Spain often look up to the Golden State's expertise. Part IV concludes by describing which lessons can be drawn from the response to the drought in Catalonia for other jurisdictions.

II. AN OVERVIEW OF THE CATALAN WATER SYSTEM

This section provides a novel, descriptive account of the institutional details of water supply in Catalonia, Spain. Barcelona and its densely populated suburbs provide a compelling case study because its issues with water scarcity mirror the struggles increasingly faced by urban areas throughout the world. Barcelona is not settled in the most water rich area, and its demand has long grown to levels where it exceeds immediate available supply, particularly when periodical drought episodes strike. This section offers an institutional overview of Catalanian water supply and usage.

In Spain, water is public property, and its management is controlled by administrative agencies. Typically, the water agencies deciding on the allocation of water are either the basin authorities (*Confederaciones Hidrográficas*) or the agencies set forth by regional government, depending on whether the basin is under the power of the central or regional government. In Catalonia, there are two relevant basin agencies: the *Confederación Hidrográfica del Ebro* for the Ebro Basin, which is shared with several other regions, and *L'Agència Catalana de l'Aigua* (ACA), which is in charge of the Internal Basins.⁵ These two agencies are in charge of long-term planning and, following a cumbersome administrative procedure, granting permits for water use.

The agencies may subsequently review the permits in order to reduce the volume granted. However, it is not common for them to do so because some user groups, like farmers, are extremely powerful.⁶ The Spanish or Catalan legislative or executive branches

4. See generally Joseph W. Dellapenna, § 9.01, *The Early Regulation of Riparian Rights*, in *WATERS AND WATER RIGHTS* (Amy K. Kelley ed., 3d ed. 2016). For an account of the evolution to regulated riparianism, see Joseph W. Dellapenna, *The Evolution of Riparianism in the United States*, 95 MARQ. L. REV. 53, 85 (2011).

5. ACA is a public body which operates under private law for most of its activities. Decret legislatiu 3/2003, de 4 de novembre, pel qual s'aprova el Text refós de la legislació en matèria d'aigües de Catalunya [Legislative decree approving the Consolidated text of Catalan legislation in relation to water] art. 7.2 (DOGC 2003, 4015).

6. Antonio Embid Irujo, Universidad de Zaragoza, Conference Paper for EXPO Zaragoza 2008: Asignación

not only set the framework for these basin institutions, but they also make some of the operational decisions, even in times of emergency.⁷ In the 2007-2008 drought, the Spanish government decided on the building of interconnections, and the Catalan legislature imposed duties on utility companies and passed general restrictions curtailing the water use rights of irrigators.⁸ ACA also manages *Aigües Ter-Llobregat* (ATLL), the main wholesale distributor in Catalonia. It supplies water to the gates of more than one hundred municipalities.⁹ ATLL holds water use rights in different rivers of the Internal Basins, is the titleholder to several wells, and owns desalination plants.¹⁰ In total, it supplies 65% of the water used in the Metropolitan Region. The other 35% is self-supplied from the different sources (surface water, groundwater, etc.) by the water utilities themselves.¹¹ At the local level, the municipal government is responsible for water provisions in their municipalities, and it may decide to manage it publicly or to outsource management to a private company. In the case of Barcelona, the private company *Aigües de Barcelona* supplies the city and twenty-two other municipalities,¹² serving as a good example of horizontal integration and explained possibly by economies of density. To supply Barcelona and its surrounding area, *Aigües de Barcelona* buys water from ATLL and from desalination plants, and it holds surface and groundwater rights.¹³

It is important to note that farmers, especially those with small operations, do not hold permits. Instead they receive water from irrigation institutions, which hold the water rights licenses. In Spain, these institutions are organized in *comunidades de regantes* (irrigation communities), which are semi-public bodies. Farmers pay for their water, but tariffs are highly subsidized. The rate-setting power lies in the *comunidad*, but the basin authority has veto power.¹⁴ The members of these communities were the potential sellers in the water markets discussed in the Segre and Ebro regions during the 2007-2008 drought. The interlocutors of the public administrators were not individual farmers but these communities, the *Comunitat General de Regants dels Canals d'Urgell*¹⁵ and the *Comunitat de*

del agua y gestión de la escasez en España: los mercados de derechos de aguas [Water allocation and scarcity management in Spain: water rights markets] 4 (2008), <http://www.zaragoza.es/contenidos/medioambiente/cajaAzul/35S11-P1-Antonio%20EmbidaACC.pdf>.

7. See, e.g., Josefina Maestu, ed., *Public Participation in River Basin Management in Spain: "Reflecting changes in external and self-created context"* 40 (HarmoniCOP Project, Workpackage 4) (2003), http://www.harmonicop.uni-osnabrueck.de/_files/_down/Spain.pdf.

8. See, e.g., Decret legislatiu 84/2007, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització dels recursos hídrics [Legislative decree 84/2007, of April 3, the adoption of exceptional measures regarding the use of water resources] art. 18 (DOGC 2007, 4860).

9. *Ámbito de actuación*, ATLL, <http://www.atll.cat/es/page.asp?id=5#> (last visited Jan. 31, 2016).

10. *Dessalinitzadora del Llobregat*, ATLL, <http://www.atll.cat/ca/page.asp?id=135> (last visited Mar. 27, 2016).

11. Joan Armengol & Josep Dolz, *L'abastament d'aigua de Catalunya i la seva garantia* [Water supply in Catalonia and its guarantee], 93-94 *NOTES D'ECONOMIA* 127, 132 (2009).

12. *Aigües de Barcelona en dades*, AIGÜES DE BARCELONA, <http://www.aiguesdebarcelona.cat/ca/aigues-de-barcelona-en-dades> (last visited Mar. 27, 2016).

13. *Fuents d'abastament*, AIGÜES DE BARCELONA, <http://www.aiguesdebarcelona.cat/ca/las-fuentes-de-abastamiento> (last visited Mar. 27, 2016).

14. Articles 81-85 of the Consolidated Water Act establish the basic regulations for these irrigation communities. See The Consolidated Water Act arts. 81-85 (B.O.E. 2001, 176) (Spain) [hereinafter CWA].

15. *COMUNITAT GENERAL DE REGANTS DELS CANALS D'URGELL*, <http://www.canalsurgell.cat> (last visited Mar. 20, 2012).

*Regants de la Dreta*¹⁶ i de l'*Esquerra de l'Ebre*¹⁷ respectively. These communities operate the infrastructure that diverts water from the stream to the individual farmers' gates. For example, the *Comunitat de Regants dels Canals d'Urgell* operates the Urgell Canal, which brings water to more than 70,000 hectares.¹⁸

III. WATER SCARCITY IN CATALONIA

Water scarcity is defined as the situation in which "demand exceeds the water resources exploitable under sustainable conditions."¹⁹ Scarcity is a growing problem in regions all over the world. The Barcelona metropolitan area suffers from a structural water deficit—a negative water balance—because local water demand is higher than water supply. It is structural because the deficit is not only present in times of drought. Droughts worsen the problem.

There are two water regions in Catalonia. One water region is supplied by the Ebro River Basin, which is a basin shared with other Spanish regions. The other, slightly larger water region is supplied by the Internal Basins, that is, rivers which only flow within Catalan territory. Given the interregional nature of the Ebro River, it is managed by a Basin Organization, the *Confederación Hidrográfica del Ebro*. Though the regional governments are represented in this organization's governing bodies, the Spanish central government plays the leading role with the greatest number of votes in the collegiate decision-making bodies and the power to appoint the highest official.²⁰ The Internal Basins are managed by an agency of the Catalan regional government (ACA), which also plays the role of the Basin Organization required by the 2000 Water Framework European Directive.²¹

These two water regions in Catalonia are different in many dimensions. For example, they have a very different distribution of uses. Ninety-five percent of the demand in the Catalan area supplied by the Ebro Basin is devoted to agricultural use, while only 36% of the demand supplied by the Internal Basins goes to agriculture.²² The other 64% of demand is distributed in the following way: 43% for urban uses and 21% for industry.²³ The Ebro is the more plentiful of the Spanish rivers, while the Internal Basins are more stressed watercourses. The Internal Basins, which cover 40% of the total Catalan demand, are the source of water for 92% of the Catalan population, mainly because they supply

16. COMUNITAT GENERAL DE REGANTS DEL CANAL DE LA DRETA DE L'EBRE, <http://www.comunitatre-gants.org> (last visited Mar. 20, 2012).

17. COMUNITAT DE REGANTS - SINDICAT AGRÍCOLA DE L'EBRE, <http://www.regantsesquerra.cat> (last visited Mar. 20, 2012).

18. *Id.*

19. *Communication from the Commission to the Council and the European Parliament addressing the challenge of water scarcity and droughts in the European Union*, at 2, COM (July 18, 2007), <http://www.eea.europa.eu/policy-documents/addressing-the-challenge-of-water>. For a broader definition, see *Hot issues: water scarcity*, FAO WATER, <http://www.fao.org/nr/water/issues/scarcity.html> (last visited Apr. 2, 2012) ("Imbalances between availability and demand, the degradation of groundwater and surface water quality, intersectoral competition, interregional and international conflicts, all contributes to water scarcity.").

20. Real Decreto Legislativo 1/2001, de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas. CWA arts. 27-29 (B.O.E. 2001, 176) (Spain).

21. Council Directive 2000/60, art. 3, 2000 O.J. (L 327) 8 (EC).

22. Armengol & Dolz, *supra* note 11, at 127.

23. *Id.*

Barcelona's Metropolitan Area.²⁴ The water supply of the Metropolitan Area is a challenge for the Internal Basins. It represents 60% of the Catalan population and produces 50% of its GDP.²⁵ Forty-seven percent of the demand in the Internal Basins region comes from the Metropolitan Area.²⁶ This distribution shows two characteristics of current scarcity crisis: the disparity between where water is allocated and where population concentrates and the tension between uses, because the majority of water is allocated to agricultural areas. The solutions employed by Catalan may serve as an example for many other jurisdictions with similar problems.

The Internal Basins are composed of mainly two systems: the Ter River and the Llobregat River, which are increasingly interconnected.²⁷ The stressed Llobregat River flows into the Barcelona area, but not the Ter River,²⁸ which is more plentiful and supplies more water. Infrastructure was established to ensure supply from the Ter to the Metropolitan Area, to which this river is the principal contributor.²⁹ Both rivers have been dammed in order to mitigate the uneven temporal distribution of water, guaranteeing supply.³⁰ Interconnections solve problems of spatial distribution, and dams level out temporal distribution. But the evolution of supply and demand, coupled with drought crises, has deemed these measures insufficient.

The spatial deficit makes the Barcelona area very dependent on neighboring areas. This deficit is particularly troublesome in an area with climate variability, which means that water is unevenly distributed across the year and across the territory. In drought times,

24. *Id.* at 128.

25. *Id.*

26. *Id.* Carla Romeu Dalmau, Judit Perarnau Terradellas & Laia Domènech Pretus, Conference Paper for the XI Coloquio Ibérico de Geografía: *Medidas de urgencia frente a medidas preventivas ante la sequía: una reflexión para el caso de la región metropolitana de Barcelona* [*Urgent Measures versus Preventive Measures to Tackle Drought: A Reflection for the Barcelona Metropolitan Area*] 6 (Jan. 2008) (on file with the author).

27. *Estació distribuïdora de Fonsanta* [*Distribution Plant at Fonsanta*], ATLL, <http://www.atll.cat/ca/page.asp?id=133> (last visited Apr. 3, 2011) (A new pipeline will unite the Ter and the Llobregat River Systems by uniting two pumping stations in the outskirts of Barcelona. The pipeline can be used in two directions.); *La xarxa de distribució*, ATLL, <http://www.atll.cat/ca/page.asp?id=32> (last visited Mar. 27, 2016).

28. Interview with Gabriel Borràs & A. Diéguez, ACA's adjunct director and supply manager respectively, Barcelona, Jan. 3, 2011. Comparing the prices of water extraction and treatment illustrates the difference between the stress on these two watercourses. Water from the Ter River costs 0.08€/m³ and the more polluted Llobregat River is 0.24€/m³. This data was obtained in personal communication with officials from the Catalan Water Agency.

29. ACA, EL AGUA EN CATALUÑA [WATER IN CATALONIA] 18 (2008), http://aca-web.gencat.cat/aca/document/ca/publicacions/aigua_a_catalunya/aigua_a_catalunya_es.pdf (last visited Apr. 2, 2012) (200 hm³ per year are discharged from the Ter, while 160 hm³ are discharged from the Llobregat).

30. There are several dams in the two systems. In the Ter, we find the Sau (completed in 1962), Colomers (1967), Susqueda (1968), and El Pastoral (1962). In the Llobregat, we find La Baells (1976), La Llosa del Cavall (1998), Sant Ponç (1954), and Sant Martí de Tous (1997). There are many differences among these dams and reservoirs. For example, the Sau dam covers 572.8 hectares while the Sant Martí de Tous covers only fifteen hectares. The dams and reservoirs are mainly owned by the Catalan Government through the ACA, except for Susqueda and El Pastoral, which are owned by a hydroelectric company. In addition, in other rivers, there are dams owned by industrial companies or irrigation communities. Data is available on the website of EL MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE [DEPARTMENT OF AGRICULTURE, NUTRITION, AND THE ENVIRONMENT], <http://sig.marm.es/snczi/visor.html?herramienta=EstadisticasPresas> (last visited Apr. 2, 2012); ACA, TECHNICAL CHARACTERISTICS AND CAPACITY: INLAND BASINS, http://aca-web.gencat.cat/aca/appmanager/aca/aca?_nfpb=true&_pageLabel=P1226354461208201575707 (last visited Apr. 3, 2012).

when rainfall drops, the problem becomes more acute. The problem is likely to get worse, given the expected impact of climate change in Mediterranean regions.

Barcelona, like many other cities all over the world, is not located in the most water abundant area. In addition, Barcelona and Catalonia in general have suffered from the same drivers of scarcity that regions all over the world face, making the deficit worse. Those drivers are population growth and urban sprawl, which go hand-in-hand with changes in consumption patterns. Barcelona's Metropolitan Area has increased from 3.5 million inhabitants to 4.5 million inhabitants in the last forty years.³¹ Rather than population increasing in the main city, it has increased in the outer zones of the metropolitan area where density is much lower.³² Urban sprawl is associated with more spacious houses with small gardens or swimming pools. Those areas consume more than dense cities and town in the metropolitan area and have driven the absolute increase in water consumption.³³ Furthermore, urban development planning has not always adequately taken into account future water needs. As a consequence, nowadays, some cities are struggling for water because that is where population changes have concentrated. Water demands should be included in urban planning strategies. In some places, cities seem to have learned from past mistakes and have started to integrate land use and water supplies. Californian legislatures and courts have required developers to include in their plans water supplies ensuring future reliability.³⁴ The deficit of the Internal Basins is estimated to be around 300-350 hm³ per year.³⁵

Like in many other jurisdictions, while these changes took place, water allocation did not vary substantially. The agricultural sector has been, and is, the main consumer of water in many regions all over the world as a result of its historical relevance and the fact that water is one of the main production inputs for irrigated agriculture. Globally, agriculture is responsible for 70% of all withdrawals of fresh water.³⁶ This is a common pattern in the distribution of water across uses in several jurisdictions. The agricultural sector uses 75% in Spain.³⁷ As in many other jurisdictions, the mismatch between this figure and the contribution of agriculture into the gross domestic product³⁸ is usually criticized. Farmers

31. *Un estudio afirma que el área metropolitana de Barcelona está llegando a Lleida y Tarragona* [A study concludes that Barcelona's metropolitan area extends to Tarragona and Lleida], EL PAÍS, 8 June 2000 http://el-pais.com/diario/2000/06/08/catalunya/960426452_850215.html (last visited Mar. 27, 2016).

32. Josep Roca Cladera, *Informe sobre l'evolució de la població de Barcelona i la seva àrea metropolitana 1996-2001: Conclusions* [Report on the Evolution of the Population of Barcelona and its Metropolitan Area 1996-2001; Conclusions] (Universitat Politècnica de Catalunya 2002), http://www-cpsv.upc.es/documents/Poblacio_BCN_2001.pdf.

33. *L'àrea metropolitana de Barcelona, la que més aigua estalvia d'Europa* [Barcelona's metropolitan area, the one which saves more water in Europe], EL PUNT, 28 July 2010, <http://www.elpuntavui.cat/article/-/5-societat/200430-larea-metropolitana-de-barcelona-la-que-mes-aigua-estalvia-deuropa.html>. For a general explanation of the effects of Romeu et al., *supra* note 26, at 13.

34. ELLEN HANAK, WATER FOR GROWTH: CALIFORNIA'S NEW FRONTIER 3, 32 (2005), http://www.ppic.org/content/pubs/report/R_705EHR.pdf (commenting and evaluating compliance of California statutes requiring water supply assessments).

35. Proposta de resolució transaccional entre la proposta núm. 8 del Grup Parlamentari Socialistes-Ciutadans pel Canvi i la proposta núm. 9 del Grup Parlamentari de Convergència i Unió (Reg. 13309) 121 (Butlletí Oficial del Parlament de Catalunya 121, 2000).

36. *Coping with Water Scarcity: An Action Framework for Agriculture and Food*, 38 FAO WATER REPORTS ix (2012), <http://www.fao.org/docrep/016/i3015e/i3015e.pdf>.

37. Instituto Nacional de Estadística, *Estadísticas e indicadores del agua*, CIFRAS INE 4 (2008) (2005 data).

38. Agriculture represents 2.5% of the Spanish GDP. CENT. INTELLIGENCE AGENCY, THE WORLD

are usually blamed for their inefficient use of water and the low price they are paying for it, which is clearly at the root of the problem. This has translated into pressures towards this sector; if water has to come from somewhere to quench urban and environmental thirst, it has to be from agriculture.³⁹ Not only the balance between uses has changed, but also new uses compete for the resource. Particularly, environmental protection awareness has increased over the years, calling for non-consumptive uses of water. Stream flows have been protected for the benefits of fish and wildlife and the enjoyment of human beings.

Structural scarcity is made worse when there is a long period of reduced natural supply. The most recent drought episode in Catalonia was declared an emergency around April 2007⁴⁰—just four months after the previous 2005-2006 drought period had officially finished—and was declared to have ended on January 2009.⁴¹ Barcelona's deficit became blatant during this time. The newspapers were full of alarming news about an approaching household water curtailment if it did not rain soon or some water was supplied from new sources.⁴² The reservoirs were at around 20% of their capacity.⁴³ The crisis ended thanks to rain, but it is likely that similar water crises will arise again because of the area's water deficit.

As the next section will explain, the options available to the Metropolitan Area to tackle its structural deficit are similar to those available to water stressed regions around the world. The measures will be discussed in relation to the 2007-2008 drought crisis too. In addition to purely demand side or supply side measures, the analysis will finish with the roles that water markets could have played in this drought management.

FACTBOOK, <https://www.cia.gov/library/publications/the-world-factbook/geos/sp.html> (last visited Feb. 4, 2016). Agriculture represents slightly less than 2% of California's Gross State Product (GSP). Mechel Paggi, *California Agriculture's Role in the Economy and Water Use Characteristics*, CALIFORNIA WATER (2011), http://www.californiawater.org/cwi/docs/AWU_Economics.pdf (last visited Mar. 27, 2016). For a statement on the pressure and critique on the agricultural sector in Spain, see JOSEFINA MAESTU ET AL., *EL AGUA EN LA ECONOMÍA ESPAÑOLA: SITUACIÓN Y PERSPECTIVAS* 119-23 (Ministerio de Medio Ambiente 2007), <http://www.fnca.eu/biblioteca-del-agua/directorio/file/685-1306271426-el-agua-en-la-economia-espanola>. See *Agricultural Water Use*, CAL. DEP'T OF WATER RES., <http://www.water.ca.gov/wateruseefficiency/agricultural> (last visited Apr. 2, 2012) (emphasizing the pressure on agriculture to use water efficiently as a result of the growth of other demands in California).

39. Glennon, *Water Scarcity*, *supra* note 1, at 1888 ("Let's be clear about one thing: we are talking about transfers from rural farming areas to cities. Most of the water that will sustain the expected 15 million additional Californians is going to come from agriculture. It has to."). A 10% improvement in agricultural water use may be enough to satisfy urban demand, though climate change may make a greater improvement necessary. PETER ROGERS & SUSAN LEAL, *RUNNING OUT OF WATER: THE LOOMING CRISIS AND SOLUTIONS TO CONSERVE OUR MOST PRECIOUS RESOURCE* 84 (2010).

40. Decret 84/2007, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització dels recursos hídrics [Decree 84/2007, April 3, Adopting Exceptional and Emergency Measures in Relation to the Use of Hydroresources] (DOGC 4860, 2007) (Spain).

41. Decret 5/2009, de 13 de gener, pel qual es deroga el Decret 84/2007, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització de recursos hídrics [Decree 5/2009, Jan. 13, Repealing the Decree Adopting Exceptional and Emergency Measures in Relation to the Use of Hydroresources] (DOGC 5298, 2009) (Catalunya).

42. *Guerra del agua ante la sequía catalana* [Water war and the Catalan drought], EL PAÍS, Mar. 31, 2008.

43. Anna Ribas i Palom & David Saurí, 2008 L'Any de la Sequera (2008, The Year of the Drought),

IV. SOLUTIONS TO STRUCTURAL DEFICIT AND PERIODICAL DROUGHT

A. Demand Solutions

On the demand side, there are several measures of different natures that could be taken. Economic incentives, in particular price increases, are solutions favored by economists. Price increases translate into demand reductions. In fact, the ACA argues that while price increases have reduced consumption, the change in consumption habits⁴⁴ and other factors, such as population growth, have outweighed the savings achieved in absolute terms. An alternative to price raises are soft measures that have few short-term effects but may have long-term benefits. An example of this type of measure is the public educational campaigns about efficient water use in our homes, which are common in Catalonia.⁴⁵ Similarly, the awareness of the water problems can translate into a decrease in consumption.⁴⁶ As result of the several drought periods during the 2000s, Barcelona consumption decreased to 110 liters per person per day.⁴⁷ This has not been enough to solve the problems and implies that further reductions cannot be expected.⁴⁸ Ninety liters per person/ per year is the threshold point that the World Health Organization (WHO) established as the limit below which some sanitary problems may appear.⁴⁹ It must be highlighted that the current average consumption level is quite an achievement. For example, the 2009 New York City consumption per inhabitant is around 476 liters.⁵⁰

Amidst a drought, the government adopts mainly short-term demand measures, beyond the voluntary reduction by household users, corresponding to the given need for immediate relief. On April 3, 2007, the Catalan Government adopted exceptional and emergency measures in relation to the use of water resources.⁵¹ The measures listed in this Emergency Decree (Decree) were tiered according to the seriousness of the situation,⁵²

44. Romeu et al., *supra* note 26, at 4 (citing ACA, L'Agència i la sequera [The Agency and the Drought] (2006)).

45. *Estalvi d'aigua* [Water savings], GENERALITAT DE CATALUNYA, <http://www.gencat.cat/web/multimedia/cat/estalviaigua/index.htm> (last visited Apr. 2, 2012); *Guerra del agua ante la sequía catalana*, EL PAÍS, http://elpais.com/diario/2008/03/31/espana/1206914401_850215.html (last visited Mar. 27, 2016).

The campaigns put forward during the 2007-08 drought can be found at ACA, *Campanyes de sensibilització Sequera 2007-2008* [2007-2008 Drought Public Awareness Campaigns], GENERALITAT DE CATALUNYA <http://aca-web.gencat.cat/aca/sequera/ca/campanyes-sensibilitzacio.jsp> (last visited Apr. 2, 2012).

46. *Water savings*, *supra* note 45.

47. *Id.*

48. *Id.*

49. Joan Armengol & Josep Dolz, *L'abastament d'aigua a Catalunya i la seva garantia*, [Water provision in Catalonia and its guarantee], 93-94 *NOTA D'ECONOMIA* 127, 133 (2009), http://economia.gencat.cat/web/content/documents/articles/arxiu/l_abastamentd_aiguacatalunyailasevagarantia.pdf (last visited Jan. 30, 2016).

50. NEW YORK CITY GOVERNMENT, *HISTORY OF DROUGHT AND WATER CONSUMPTION*, http://www.nyc.gov/html/dep/html/drinking_water/droughthist.shtml (last visited Apr. 2, 2012).

51. Decret 84/2007, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització dels recursos hídrics (Catalunya).

52. *Id.* There were three main scenarios. The level one scenario employs measures which will ensure that water will be available in the medium-term. The level two scenario establishes tighter measures to guarantee domestic uses in the short-term. The level three scenario, or emergency scenario, is the most serious one and entails extraordinary and serious restrictions, including restrictions to household consumptions (for example, water could have been unavailable at nights). For example, the Ter-Llobregat system enters into a level 1 scenario when the level of reservoirs drops below 33 percent. The center will enter into a level two scenario if the stored water is below 23% of reservoir capacity. If the reservoir drops to below 20%, then the systems enters the emergency scenario. The Decree itself entailed the declaration of a level 1 scenario. Art 2 of the Decree 84/2007

and the seriousness is measured according to the amount of water in the reservoirs. Here the measures are going to be analyzed according to whether they are targeting the demand or the supply side.

Diverse obligations were imposed on water utility companies, municipalities, households, farmers, and industries by this Decree.⁵³ The principal measures implemented were restrictions on irrigation.⁵⁴ The underlying assumption seemed to be that the water marginal value is lower in agriculture than in domestic or industrial uses. The Decree established the maximum amount of water that can be taken from the river for irrigation purposes, thereby curtailing the farmers' permits.⁵⁵ The amount of water available for crops decreased depending on the seriousness of the drought situation. For example, initially the restriction set less water available for all the crops, but if drought aggravated, restrictions were established at the level of survival for perennial crops, like fruit trees, which have high fixed costs.⁵⁶ At that point, there was no allocation for less valuable crops. Almost any measure or limitation adopted—for example, restrictions on irrigation rights—were not compensable, except the ones that were a direct takings.⁵⁷ However, it must be noted that the lack of direct compensation for the restriction on irrigation rights was somehow cancelled out by the direct subsidies that farmers received for the loss of crops due to drought.⁵⁸

Water use by municipalities were also restricted starting from level 1 scenarios.⁵⁹ They could not use water of quality suitable for human consumption for uses other than that, like irrigating public parks.⁶⁰ This measure can have long term effects because systems for reusing water for irrigation of public areas or fountains could create permanent water savings—as it has been the case in the city of Barcelona.⁶¹

defines the scenarios and the rest of the provisions establish the specific restrictions and the specific triggers for each basin. Decret 84/2007, Art. 2, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització dels recursos hídrics (Catalunya).

There are examples not too far away, like Sevilla, where household water suffered severe restrictions from 1992 to 1996; there were periods where water was unavailable for up to ten hours per day. See Antonio M. Rico Amorós, *Sequías y Abastecimiento de Agua en España* [Droughts and Water Distribution in Spain], 37 BOLETÍN OFICIAL DE LA AGE 137, 170 (2004).

53. Decret 84/2007, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització dels recursos hídrics (Catalunya).

54. *Id.*

55. *Id.*

56. *Id.*

57. *Id.*

58. For the drought period of 2007-2008, the subsidies have essentially become loans offered by a public institution at lower interest rates. For example, the farmers growing flowers received loans to distribute the losses caused by the drought over several years. In addition, given the current financial crisis, they received subsidies to cover these already favorable loans, see ORDRE AAR/433/2010, de 6 de setembre, per la qual es convoquen els ajuts per bonificar els costos financers dels préstecs per la sequera de 2008 als titulars d'explotacions agràries de flor i planta ornamental [Order AAR/443/2010, Sept. 6, announcing the call for subsidies for owners of flower and decorative plant farms in order to pay for the financial costs of loans related to the 2008 drought], (DOGC 5713, 2010).

59. Ajuntament de Barcelona, *L'Ajuntament presenta les seves mesures per lluitar contra la sequera* [Barcelona City Council, *The City Council announces its measures to fight against drought*], BARCELONA, Jan. 14, 2008, <http://w110.bcn.cat/fitxers/premsa/070114rdpplasequera.285.pdf> (last visited Apr. 3, 2012).

60. *Id.*

61. For a list of measures taken during the 2007-2008 drought, Ajuntament de Barcelona, *L'Ajuntament presenta les seves mesures per lluitar contra la sequera* [Barcelona City Council, *The City Council announces its measures to fight against drought*], BARCELONA, Jan. 14, 2008, <http://w110.bcn.cat/fitxers/premsa/070114rdpplasequera.285.pdf> (last visited Apr. 3, 2012). For the current environmental management

Restrictions on household consumption were the last resort, they would have only been adopted in emergency scenarios. But local authorities—which are the level of government responsible for urban water supply—are empowered by the Decree to adopt immediate measures to ensure an efficient use of water.⁶² For example, they could restrictively regulate the irrigation of private gardens, patios, or lawns.⁶³ In fact, the Catalan government conditioned on the adoption of these measures the funding for infrastructure projects to reduce the burden on current local, water supplies or to increase water supplies.⁶⁴ In addition, a mandate to plan and implement measures to reduce water stress was imposed on water utility companies supplying areas of more than 20,000 inhabitants. For example, Aigües de Barcelona, in Barcelona, decided to improve the conveyance infrastructure by reducing leaks and reducing water pressure, which reduces consumption and conveyance losses.⁶⁵ Thus achieving a 2% reduction in the volume of water used.⁶⁶ As shall be seen, the curtailments established and the shielding of domestic uses prevents the market from fulfilling a similar reallocation where every user faces the real cost of the water.

B. Supply Solutions

Water supply is generally considered fairly inelastic given the high costs of “producing” new water. The traditional solution for increasing supply has been to build dams to smooth the availability of water across the year. But this is no longer an option in Catalonia because of the number of dams already present in both internal river systems and the high political, economic, and environmental costs of building new dams. Water supply could, however, be increased in several other ways in Catalonia. First, without resorting to new sources of water, water availability could be increased by improving existing infrastructure in order to reduce transportation losses. For example, in Barcelona, 25% of the water that enters into the system is not billed,⁶⁷ and in Badalona, a city in the Metropolitan Area, a pipe lost more than 9,000 liters of water per hour for weeks.⁶⁸

Second, even though groundwater is already a source for Barcelona, more aquifers could be utilized if they were restored, properly managed, and sometimes cleaned.

of Barcelona’s public spaces, Ajuntament de Barcelona, *Green Spaces, Environmental Management*, <http://w110.bcn.cat/portal/site/MediAmbient> (choose “English,” follow “green spaces,” then “Parks and gardens of Barcelona,” and then “Environmental Management”).

62. Decret 84/2007, art. 5, de 3 d’abril, d’adopció de mesures excepcionals i d’emergència en relació amb la utilització dels recursos hídrics (Catalunya).

63. *Id.* art. 14.3.

64. *Id.* art. 14.5.

65. Ioanna Livaniou, *Evaluating Asset Management Strategies of Water Cycle Systems Under Difference Socio-Technical Contexts* (Nov. 14, 2014) (unpublished master’s thesis, Delft University of Technology), http://www.citg.tudelft.nl/fileadmin/Faculteit/CiTG/Gezondheidstechniek/doc/Afstudeerrapporten/Livaniou_Evaluating_Asset_Management_Strategies__1_.pdf.

66. *Id.* at 21.

67. See SALVADOR RUEDA, BARCELONA, CIUTAT MEDITERRÀNIA, COMPACTA I COMPLEXA. UNA VISIÓ DE FUTUR MÉS SOSTENIBLE [BARCELONA, MEDITERRANEAN CITY, COMPACT AND COMPLEX] 60 (2002) (This percentage includes water lost due to aging infrastructure—estimated to amount between eight and ten percent—illegal uses, bulk agreements, etc.).

68. *Una tubería rota pierde 216.000 litros de agua al día a su paso por Badalona*, ABC NACIONAL, Feb. 28, 2008, http://www.abc.es/hemeroteca/historico-27-02-2008/abc/Nacional/una-tuberia-rot-pierde-216000-litros-de-agua-al-dia-a-su-paso-por-badalona_1641682087452.html.

Third, water reuse can be a source of water for certain uses. Recycling sewage water is common for uses other than urban household consumption, but there are also interesting experiments of waste water recycled for human consumption in Singapore and in Orange County.⁶⁹ However, Catalonia is still behind. It treats huge amounts of water (700 hm³)⁷⁰ but it reuses a tiny percentage (51 hm³ in 2008).⁷¹ Recycled water could be a source of water for irrigation. It is important to note that irrigators are quite reluctant to accept this water even though water is a reused asset per se.

Fourth, desalination production can be augmented to satisfy current deficits, but its economic and environmental costs are very expensive. Desalination keeps alive the idea that water is infinite. As a response to the drought, new desalination plants were built or expanded, but none of them solved the immediate crisis. In late 2009, production capacity of desalinated plants reached 80 hm³.⁷² Nonetheless, in wet years, that amount is far from reach because water from desalination is expensive.⁷³ Two more plants were planned but never built.⁷⁴

Fifth, water could be transferred from other areas, but transporting water is expensive because it requires either infrastructure or tankers. For example, a transfer from the Rhône River (France) to Barcelona has been perennially discussed because this plentiful river does not suffer the same climatological stressors as the Catalan ones. Interbasin water transfers, whether they have an international component or not, are always contentious because they are environmentally and economically costly and politically controversial. The situation became harsher in 2008, given the negligible precipitations that the area received during 2007.⁷⁵ In April of 2008, the reservoirs were at 20.14% of their capacity. The domestic restrictions were close. If the stored water dropped below 20% of reservoir capacity, households will suffer restrictions. These were expected for October 2008 at the latest. At that time, a transfer from the Segre River, which is part of the Ebro Basin, was debated to alleviate the situation.⁷⁶ The connection between the Ebro Basin and the Internal

69. ROGERS & LEAL, *supra* note 39, at 28-36.

70. ACA, <https://aca-web.gencat.cat> (follow “English”; then follow “Plans and programmes”; then follow “Planning”; follow “Reuse in Catalonia”).

71. *Reuse*, ACA, http://aca-web.gencat.cat/aca/appmanager/aca/aca?_nfpb=true&_pageLabel=P1206854461208200613421&profileLocale=en (follow chart “Evolution of volume of water reused by use”).

72. See ACA, *Dessalinitzadora del Prat* (follow “English”; then follow “Action”; then follow “Desalination Plants”; then follow “Prat Desalination Plant”).

The capacity of the Tordera Desalination Plant was enlarged, and the Llobregat Desalination plant was inaugurated in 2009. These are the amounts they can produce, but actual production is adjusted according to the availability of traditional sources of water. See *La dessalinitzadora de la Tordera*, ACA, http://aca-web.gencat.cat/aca/appmanager/aca/aca?_nfpb=true&_pageLabel=P18400839711246274517685&_nfls=false (follow Tordera desalination plant).

73. Els embassaments del Sistema Ter Llobregat reserven aigua per 6 mesos per abastament, regiusos ambientals, LA VANGUARDIA (Oct. 30, 2014), <http://www.lavanguardia.com/local/barcelona/20141030/54418735440/els-embassaments-del-sistema-ter-llobregat-reserven-aigua-per-6-mesos-per-abastament-reg-i-usos.html>.

74. Chris Fife-Schaw, *Strategies for Addressing Water Shortages*, TECHNEAU 18 (Dec. 2010).

75. Since February 2008, the Ter and Llobregat systems were at level 2 exceptionality, see ACA, MEMÒRIA DE LA SEQUERA DEL 2007-2008 (REPORT ON THE 2007-2008 DROUGHT) 63 (2008), http://aca-web.gencat.cat/aca/documents/ca/publicacions/memoria2008/memoria_aca_2008_ebook/index.html#61 (last visited Apr. 2, 2012).

76. Arnau Urgell, *Transvasament de la Conca Alta del Segre a l'àrea metropolitana de Barcelona* [Transfer

Basins could be easily built since the headwaters of the Llobregat River and the Segre River are close to one another. It also could have benefited from the Cadi tunnel, a road tunnel built in 1984 that connects the two areas. Apart from the short term relief these exchanges would have provided—probably thanks to water coming from fallowed fields—this project could have had good future prospects. Water could have been freed by improving irrigation techniques and sold by farmers to the Metropolitan Area municipalities. Careful monitoring to avoid externalities would have been needed since irrigation occurs down the river, and the catchment point that provides water for Barcelona would have occurred in the headwaters. In addition, water infrastructure could have been used bi-directionally, and thus, farmers could have been water receivers. Since this is so, an even more innovative solution could have been implemented, such as substituting irrigation water for reused water, and thus freeing up the clean irrigation water to go to Barcelona. However, the Segre option was disfavored by farmers, local authorities, and, most importantly, the central government, whose approval was needed for any infrastructure work connecting an interstate basin.⁷⁷ The central government never approved the Segre connection and subsequent transfer.

The harsh situation during the Spring of 2008 compelled the Spanish central government to pass a Real Decreto-Ley,⁷⁸ a type of act reserved for extraordinary situations, which added to the measures taken by the Catalan Government. Even though the Segre transfer had been discarded, this Spanish act authorized the connection of Barcelona with Tarragona, a town in the south of Catalonia that receives water from the Ebro River. Once built, this connection would have allowed a water transfer from the agricultural area part of the Ebro system to the Internal Basins.⁷⁹

The connection entailed a transfer pipe, which was not a mammoth project. It was relatively cheap to install and it did not have a huge environmental impact. The project was designed to be installed in the median of the highway that unites Barcelona with Tarragona (AP-7). Even though a pipe can be useful to send water either way, it seemed clear who would be the recipient anytime: the Metropolitan Region. To calm the protests from the Tarragona region, it was decided that the structure would be temporary.⁸⁰ The expected

from the Upper Segre River Basin to the Metropolitan Area], TERRITORI, http://territori.scot.cat/cat/noticies/2008/12/transvasament_de_la_conca_alta_del_segre_a_l_Area_metropolitana_de_barcelona_2008_172.php (last visited Mar. 27, 2016).

77. The concept of basin varies from jurisdiction to jurisdiction. According to the European Water Framework Directive and the Spanish legislation, a basin includes a river which flows into the sea and all its tributaries. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000: establishing a framework for Community action in the field of water policy, 22.12.2000 OFFICIAL J. EUROPEAN CMTYS. 1, 6; CWA, art. 16 [Real Decreto Legislativo 1/2001], de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas (B.O.E. 2001, 176). According to this definition, the Yellowstone River would not be considered an independent basin, and instead it would be managed as part of the Missouri River basin; but in the United States these rivers are managed separately.

78. Real Decreto-ley 3/2008, de 21 de abril, de medidas excepcionales y urgentes para garantizar el abastecimiento de poblaciones afectadas por la sequía en la provincia de Barcelona [Royal Decree-Act 3/2008, Apr. 21, of exceptional and urgent measures to guarantee the provision to localities affected by the drought in the Barcelona's province] (B.O.E. 97, 2008) (Spain).

79. *Id.*

80. *ERC irá a la manifestación contra el minitransfer acordado por los Gobiernos central y catalán* [ERC will go to the demonstration against the minitransfer agreed by the central and Catalan governments], EL PAÍS, Apr. 21, 2008, http://elpais.com/elpais/2008/04/21/actualidad/1208765837_850215.html.

cost was 180 million euros, and its installation was expected to be completed within two months.⁸¹

It was a very controversial project from the beginning. Some years before, the Popular Party, while governing in the central government, put forward a National Hydrologic Plan that included a transfer of 190hm³ per year from the Ebro River to the internal basins of Catalonia.⁸² The Socialist government later partly repealed the plan in fulfillment of one of its electoral promises. This smaller transfer project would have conveyed only forty hm³ per year, and this water was part of the allocation from the Ebro that Tarragona was not consuming. There had been a huge opposition to the initial Ebro transfer, which the Socialist party had used as an electoral platform. The Socialist Party held many positions in the government when the Tarragona connection was being debated. Public discontent, channeled through the organizations that opposed the previous plan, targeted the Socialist central government, the Socialist Party, and other left-wing parties in Catalonia because they allowed this smaller connection after having opposed the previous one.⁸³ Detractors feared that once the faucet opened, there would be no way to stop Barcelona from receiving as much water as it wished given its capital relevance and to the detriment of southern rural and small urban areas and the environment.⁸⁴ Given the opposition to the project, it was not even called a transfer in order to circumvent the stigma it had tied to it. Instead, it was called catchment, a less loaded word.

While the Ebro project was in the early stages, given the immediacy of the crisis, water started being shipped to Barcelona by boat from Tarragona, which had a surplus of groundwater, to Marseille and the Provence Canal in France. The ships were expected to carry around 1.66 hm³ per month, which would have fulfilled around 6% of the demand in the Metropolitan Area while the drought period lasted. This was an incredibly expensive source, even though transportation was cheaper thanks to the harbor fee waiver granted by

81. *Id.*

82. Ley 10/2001, de 5 de julio, del Plan Hidrológico Nacional (Act 10/2001, July 5, National Hydrologic Plan) (B.O.E. 61, 2001) (Spain). The National Hydrological Plan was passed by the Spanish Legislature in 2001. Its provisions regarding transfers to the Catalan Internal basins and the Segura and Júcar Basins were particularly polemic with plenty of public opposition. For example, the “Plataforma per la Defensa de l'Ebre” — an association for the defense of the Ebre River which was started by citizens of the area near its delta — organized a demonstration on September 9, 2001 in front of the European Institutions in Brussels. For a report on the different protests, see Instituto Aragonés del Agua, *Crónica de la lucha contra el trasvase* (Report on the struggle against the transfer), <http://www.aragon.es/DepartamentosOrganismosPublicos/Organismos/InstitutoAragonesAgua/AreasTematicas/PlanHidrologicoNacional> (follow “Crónica de la lucha contra el trasvase”) (last visited Apr. 3, 2012).

The Socialist Party was against these transfers and promised to derogate them if it won the election. After winning the 2004 election, it passed the Ley 11/2005, de 22 de junio, por la que se modifica la Ley 10/2001, de 5 de julio, del Plan Hidrológico Nacional [Act 11/2005, June 22, modifying Act 10/2001, July 5, of the National Hydrologic Plan] (B.O.E. 149 23.07.2005), which repeals these transfers, arguing that their negative effects had been undervalued.

83. Un trasvase políticamente correcto [A politically correct transfer], ABC (Mar. 18, 2008) http://www.abc.es/hemeroteca/historico-18-03-2008/abc/Sociedad/un-trasvase-politicamente-correcto_1641729666056.html. For the critique of the left-wing parties, see *Corbacho i CiU coincideixen en criticar el paper d'ERC davant el minitransvasament de l'Ebre* [Corbacho i CiU agree in their critique of ERC's position in relation to the Ebro's mini-transfer], DIARI DE GIRONA (Apr. 23, 2008), <http://www.diaridegirona.cat/catalunya/2008/04/23/corbacho-ciu-coincideixen-criticar-paper-derc-davant-minitransvasament-lebre/261609.html>.

84. For an account on the opposition to the smaller transfer, see Arnau Ugell, *Transvasament del Consorci d'Aigües de Tarragona a l'Àrea Metropolitana de Barcelona* [Transfer from the Tarragona's Water Consortium to the Barcelona Metropolitan Area], Observatori de projectes i debats territorials a Catalunya, Dec. 31, 2008, <http://territori.scot.cat/cat/viewer.php?IDN=174> (last visited Apr. 4, 2012).

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the Spanish central government. Cost of water shipped by boat was above 13€/m³,⁸⁵ while water from the Ter river cost only 0.08€/m³.⁸⁶

The Ebro transfer was never completed. Rains in late April and early May of 2008 moved the risk of household curtailments further away. On June 5th, the Spanish Government suspended the Decree-Act that allowed the connection.⁸⁷

C. Water Markets, the Missing Piece

Finally, there is the option of pursuing policies that affect both supply and demand: water markets. Those were the missing pieces of the response to the 2007-2008 drought in Catalonia.

By water markets, I consider any mechanism, temporary or permanent, which allows users with different marginal values to transfer the right to use water. The most common experiences are water banks, environmental water accounts, and contracts between private parties. Each of them requires different roles from the government. For example, in a water bank, the administrative agency responsible plays the role of a broker, which may imply some backup functions necessary at early stages of market development since parties might be unfamiliar with water transactions. But even if the market consisted only of private contracts, government would have to play certain roles, such as reviewing transactions for externalities, given the potential failures present in water markets. The lack of governmental spur might be the reason why water markets have not been a useful tool in Spain even though they are legally feasible.

The purpose of water markets are to bring water from water-abundant to water-scarce areas by reducing water demand from low value uses, such as agriculture, and supplying that water to higher-value users, such as urban users. If markets existed, the drought situations should not become as harsh as they are nowadays in regimes like the Spanish one, where the agency responsible for water allocation decides which categories of rights to curtail, without paying attention to the specific marginal values of their right holders. If users could buy, sell, or lease their rights, the expected result is that those who value the water most will be the primary ones who use it, thus reducing the potential losses from a drought. Furthermore, given that increasing the water supply is not a solution in addressing the scarcity problem in the majority of region, markets could provide a way to reallocate

85. The amount of water shipped per month was expected to be 1,660,000 m³, and the expected monthly cost 22 million euros. See GENERALITAT DE CATALUNYA, *Arriba el primer vaixell amb aigua potable al port de Barcelona* [The First Ship With Drinking Water Arrives to Barcelona's Port], http://www20.gencat.cat/docs/Sala%20de%20Premsa/Documents/Arxiu/mah_premsa.notaPremsa.63.11210663808665.pdf (last visited Apr. 3, 2012).

86. Personal communication with officials from the Catalan Water Agency.

87. Resolución de 6 de junio de 2008, de la Secretaría de Estado de Medio Rural y Agua, por la que se publica el Acuerdo del Consejo de Ministros de 6 de junio de 2008, por el que se declara la concurrencia de la causa de cese de la vigencia del Real Decreto-ley 3/2008, de 21 de abril, de medidas excepcionales y urgente para garantizar el abastecimiento de poblaciones afectadas por la sequía en la provincia de Barcelona [Resolution, June 6, 2008, of the Secretary of State for Rural Water, which publishes the Agreement of the Council of Ministers of June 6, 2008, declaring the concurrence of the cause of cessation of the force of Royal Decree-Law 3/2008, April 21, of exceptional and urgent measures to ensure supplies of drought-affected populations in the province of Barcelona] (B.O.E. 138, 2008).

water. The majority of regions are already over allocated and new sources, such as desalination, are too expensive. But markets would provide a far more flexible system, without political distortion.

Markets would provide farmers with the incentives to adopt efficient irrigation techniques or to adjust their crop types, and would allow users to shield their risks of curtailment. Markets, thus, are both a demand side measure and a supply side one, ensuring that water flows to those who value it the most. Demand in the agricultural sector would decrease because the benefit from using the water to irrigate is lower than the benefit they will obtain from selling it. Given that they reduce demand, any supply available for other users would increase because the water rights that irrigators hold are for lease or sale. These mechanisms should be less controversial than mandated transfers since mandated transfers decrease supply in the region of origin that could translate into environmental problems and restrictions for the right holders during future droughts. If markets existed, the right holders of these regions could decide whether to lease or sell water and benefit from it. Similarly, administrative mandated cuts assume uses are more or less valuable and reduce their permits, but such an assessment by the administration is likely to be less precise than decentralized private parties decision when facing the real cost of water. Farmers could choose to irrigate or sell it to urban utilities. Urban utilities may decide to reduce their customers' demands by increasing the price, adopting other measures, or buying the water from farmers. However, such a scenario will not likely be realized in Spain because water market regulation is flawed, as the next subsection will demonstrate by using California as a benchmark. Emergency measures further hinder water markets.

1. Water Markets Regulation in Spain: A Bad Disciple of California

Water rights in Spain were transferable under the 1985 Water Act, but transactions were few since the procedure was so cumbersome, taking up to eighteen months to get an approval of the transfer between two private parties.⁸⁸ In 1999, an overhaul of Spanish water regulation was introduced. Two different types of exchanges were allowed: first, leasing contracts—private parties could enter into lease contracts for water use permits⁸⁹—and second, exchanges within the framework of a water bank allowing them to sell or lease these to other users. A water bank is an administratively-run clearinghouse where the agency establishes the buying and selling price and issues permits for holders to sell or lease their water use rights to the bank.⁹⁰ The drought period in the early 90s was a precursor of this regulation, but as will be explained in the next section, it was not enough to prevent the harsher effects of the mid 2000s drought or to resolve the structural problem.⁹¹

88. José Luis Moreu Ballonga, *Una explicación jurídica sobre el Mercado del agua* [A legal explanation of the Water Market], EL PAÍS (May 31, 1999), http://elpais.com/diario/1999/05/31/sociedad/928101610_850215.html.

89. CWA, arts. 67-70 [Real Decreto Legislativo 1/2001], de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas (B.O.E. 2001, 176).

90. *Id.* art. 71.

91. Ley 1999/46 (B.O.E. 1999, 298), preamble:

En este sentido, la experiencia de la intensísima sequía, padecida por nuestro país en los primeros años de la década final de este siglo, impone la búsqueda de soluciones alternativas, que, con independencia de la mejor reasignación de los recursos disponibles, a través de mecanismos de planificación, permitan, de un lado, incrementar la producción de agua mediante la utilización de nuevas tecnologías, otorgando rango legal al régimen

Since this article aims to offer lessons beyond Catalonia for the West of the U.S., it is important to note the Californian experience during the 1999 political debate concerning the bill to amend the 1985 Water Act.⁹² Scholars have recognized that California provides a good comparison to Mediterranean jurisdictions. In his analysis of the 1991 California Bank, Howitt acknowledges the similarities between Mediterranean regions and the “Golden State”:

Mediterranean water economies are characterized by the same problems and climate that face California, namely spatial and temporal inequalities of water allocation.

Throughout the Mediterranean region urban and environmental water demands continue to grow, while agricultural water users wish to retain the cheaper water that was developed earlier. Nowhere is this problem more acute than in the economy of the State of California, USA, which in terms of its water uses, climate and conflicts has close parallels to Mediterranean countries.⁹³

Since Spain is an example of a Mediterranean jurisdiction, this quotation supports the meaningfulness of the comparison chosen here. In fact, drawing on similar characteristics, Arroyo and Naredo, two Spanish scholars, offered in their 1997 book a descriptive comparison of Californian and Spanish water policy,⁹⁴ including its markets.

When debating water markets in the Spanish Congress, opposing parties in Spain treated the Californian experience strategically. The Socialist Party, in the opposition at the time of the reform, defended water banks based on the Californian experience, but explicitly opposed markets.⁹⁵ In contrast, Mr. Blanco, the right wing party Water Secretary, regarded California as a successful experience—but his reform went beyond water banks, which many seemed to consider the only transfer mechanism available in California.⁹⁶ The potential negative effects are attenuated because the user can only transfer the average volume that was used during the last five years.

jurídico de los procedimientos de desalación o de reutilización, de otro, potenciar la eficiencia en el empleo del agua para lo que es necesario la requerida flexibilización del actual régimen concesional a través de la introducción del nuevo contrato de cesión de derechos al uso del agua, que permitirá optimizar socialmente los usos de un recurso tan escaso. [In this sense, the experience of the intense drought suffered by our country in the early years of the final decade of this century, calls for the search of new alternative solutions, which, regardless of the best reallocation of available resources through planning mechanisms. These new solutions should, on the one hand, increase water production using new technologies, granting legal status to legal procedures desalination or reuse, and, on the other, enhance efficiency in water use given the flexibility needed under the current concession regime through the introduction of the new contract for the transfer of rights to use water, which will optimize socially uses of such scarce resource].

92. See Comisión de Medio Ambiente, Comisión de Medio Ambiente, Session No. 38 (1999) (Diario de Sesiones del Congreso de los Diputados 1999, 723).

93. Richard E. Howitt, *Empirical Analysis of Water Market Institutions: The 1991 California Water Market*, 16 RES. & ENERGY ECON. 357, 358 (1994).

94. PEDRO ARROJO & JOSÉ MANUEL NAREDO, *LA GESTIÓN DEL AGUA EN ESPAÑA Y CALIFORNIA* (1997).

95. *El PSOE planteará hoy al Gobierno su rechazo a los mercados de agua*, EL PAÍS (Mar. 15, 1999), http://elpais.com/diario/1999/03/15/sociedad/921452410_850215.html.

96. Juan Fernández-Cuesta, *El Mercado del Agua queda bajo control con un precio máximo de 60 pesetas por metro cúbico*, ABC 86 (“Hay experimentos de mercados de agua que han funcionado muy mal en el mundo,

A rough estimate of transactions from 2000 to 2009 is that only 296,521.785 acre-feet were transferred.⁹⁷ This is less of 1% of water used in a year and far below what is transferred in California any given year.⁹⁸ These figures suggest that water markets have not been very active, and activity is a good proxy for success in this case.⁹⁹ Three important considerations regarding the leases must be noted because they partially explain why those tools were not widely used in Spain.

First, water lease contracts must respect the legal ranking of uses, that is, water should be leased to users ranked at a same or higher level. In relation to this first point, it is important to highlight that leases only operate between sellers and buyers who are already users.¹⁰⁰

The default ranking, which is the same as that established in the 1985 Water Act, is set in Article 59 of the Consolidated Water Act, but the River Basin Plans can modify it.¹⁰¹ The default ranking is as follows: domestic users and small industry connected to the municipal water net; agriculture; hydroelectric or other electric power producers; industry; fish farms; recreation; navigation. This ranking purportedly expresses the public interest.¹⁰² But, the ranking seems to be more a proxy of the social valuation of water, probably lagging behind current times, anchored in the times when we were an agricultural society. Another hypothesis is that the relative abstract inelasticity of demand of the different uses which assumes that domestic consumers and farmers cannot do without water. This requirement of respecting the ranking in water transactions should not be an obstacle in times of drought since the idea behind water exchanges is that farmers could save water or fallow their fields because they either can increase their efficiency or lose the annual crop. They can sell it to other farmers growing higher value crops or to urban water suppliers selling water to domestic users, which are always at the top of the ranking. In addition, the ranking requirement can be waived in certain emergency scenarios.

como en Chile, y otros que han dado juego, como en California.” [“There are water market experiences which have not worked well, like in Chile, and others that did, like in California”.]

97. Data on file with the author. Jesús Yagüe-Córdova, *Experiencia de los instrumentos de mercado en España* [Experience of the MBI in Spain], EXPO ZARAGOZA (2008), <https://www.zaragoza.es/contenidos/medioambiente/cajaAzul/37S12-P1-JesusYagueCordovaACC.pdf>.

98. The annual average of the committed water amount from 1991 to 2000 is 1,843,098 acre-feet in California. Database, *California Water Transfer Records*, BREN SCH. ENVTL. SCI. & MGM'T, http://www.bren.ucsb.edu/news/water_transfers.htm.

99. This is a traditional proxy in the literature on water markets. See Jedidiah Brewer et al., *Water Markets In The West: Prices, Trading, And Contractual Forms*, 39 NAT'L BUREAU ECON., Working Paper 130002, (2007); Jedidiah Brewer et al., *Transferring Water in the American West: 1987-2005*, 40 MICH. J. L. REFORM 1021, 1031-1035 (2007) (attempting to explain the difference between the trading activity of different states using their institutional differences); Jedidiah Brewer et al., *Law and the New Institutional Economics: Water Markets and Legal Change in California, 1987-2005*, 26 WASH. U. J.L. & POL'Y 183 (2008) (legal changes are included here as explanatory variables).

100. Vanessa Casado Pérez, *Missing Water Markets*, 23 N.Y.U. ENVTL. L.J. 157, 217 (2015)

101. For example, in the River Basin Plan of the Segura River Basin industry takes precedence over electric power production. *Segura River Water Plan*, Normative Section. Another example of a plan that has slightly changed the order is the Miño-Sil River Basin Plan where section 2.1.3.1. establishes the following precedence: 1) domestic; 2) farming not irrigation; 3) industry with low water consumption; 4) irrigation; 5) industrial uses; 6) electric energy uses. *Miño Sil Plan*, Normative Section (1998).

102. Juan Fernandez-Cuesta, *El Mercado del Agua queda bajo control con un precio máximo de 60 pesetas por metro cúbico* [Water Market Stays Under Control with Maximum Price of 60 Pesetas per Cubic Meter], ABC (May 3, 1999), <http://hemeroteca.abc.es/nav/Navigate.exe/hemeroteca/madrid/abc/1999/05/03/086.html>.

Even though it seems to be less of a deterrent in practice because we assume water will be coming from the agricultural sector, the regulation is still far from optimal. The rank decided by the agency is a very rough proxy for marginal value since there might be an industry whose marginal value is higher for the extra twenty liters of water per day it needs to meet a peak in production and its water demand is very inelastic. However, industry use is ranked lower than agricultural use; thus, industry cannot lease from a farmer. Furthermore, new users cannot buy water from current users. This means that new entrants have to apply for new permits even though streams may be over-allocated. This approach is highly different from California's private transactions. Not only do rank of order limitations not exist, but also, Senate Bill 610 and Senate Bill 221 of 2001 establish that new urban developments have to ensure that water is available for the next twenty years and transfers are among the sources they can rely on to prove that supply is ensured.¹⁰³

However, the 1991 California Drought Water Bank included some priorities into its framework: there were rules to prioritize among different buyers according to how serious the effects of the shortage would be for them. Demands arising from emergency situations related to health and safety were to be satisfied first, then critical needs such as those of urban users receiving less than 75% normal supply or farmers growing permanent crops. Yet, these priorities did not need to be applied since there was less demand for water than water purchased and, thus, the California Department of Water Resources ensured more water flow and carry-over storage.¹⁰⁴

The restrictions in Spain—ranking of uses and transferring only to another user—could be justified if they translated into a less demanding review procedure because transactions that are less prone to affect third parties are the only ones allowed in the first place. Before the 1999 Amendment, when those restrictions did not exist, to complete a transaction, the authorization process was extremely cumbersome. After the Amendment, the procedure to authorize a transaction was shorter (two months), but the procedural steps were not spelled out. There is no guidance on who has the burden of proof or what the role of participation is for third parties. California has a cumbersome procedure that differentiates between long-term and short-term transactions, but guidance on the procedural steps indispensable to get that transaction through abounds.

The second problem regarding the lease mechanism is that the approval of such a transaction does not imply the authorization for the construction or use of pipes, canals, and mains. When infrastructure is private and used for permit leases, regulations establish that the owner of the infrastructure and the parties to a transaction need to agree. There is no imposition of common carrier duties.¹⁰⁵ The regulation does not rule out direct denial of permission to use or other practices such as discriminatory rates. When the infrastructure is public, the approval for the use of the infrastructure is independent from the approval of the transfer. This additional approval seems quite an unnecessary duplication of

103. *Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001*, CAL. DEP'T OF WATER RES. (Oct. 8, 2003) (to assist water suppliers, cities, and counties in integrating water and land use planning).

104. Richard Howitt et al., *Incremental Water Market Development: The California Water Sector 1985-2004*, 30 CAN. WATER RES. J. 73 (2005).

105. See CWA art. 70.

proceedings since the same administrative body—the agency managing a basin—authorizes both. Provided the infrastructure has spare capacity, there is no need for many other findings because externalities will have already been considered when reviewing the transfer. Interestingly, even the periods to decide on the transfer and on the use of infrastructure are different with the period for the use of infrastructure being longer (four months). However, a positive feature is that if the administration does not decide on time, the use of infrastructure is considered authorized. California also separates procedures if there is a need for authorization to ship water using the infrastructure, but there is a clear duty to allow third parties to transfer water using up to 70% of unused capacity.¹⁰⁶

In Spain, the consensus among lawyers who deal with lease contracts is that the authorization for the use of existing infrastructure is less of a hurdle than the use of inter-basin infrastructure,¹⁰⁷ since the latter always implies a delay and involves more complex transactions, given its greater potential for externalities. In some cases, this may become a political question, and some externalities might be disregarded to serve particular interests.

This was the case during the 2007-2008 drought crisis. In addition to the Ebro transfer, the Decree also authorized the use of the pipe for transporting water under water leasing contracts, a market mechanism. The Real Decreto-Ley authorized public agencies or private actors designated by the Autonomous Community authorities to buy rights from farmers who are members of an irrigation community in the Ebro Region. These sales which would not have been part of a water bank could not be banned by the irrigation community, but the community must send a report to the Ebro Hydrographic Confederation, the basin authority which has the power to approve the contact. This authorization did not follow the path set forth in the Consolidated Water Act, and instead it opted for an open authorization before anyone applied for it; therefore, externalities would have been disregarded. However, the connection was never built. A lack of connections contributes to the failure of water markets, and are also a consequence of that failure. The connections discussed, like that in Ebro, do not imply a great investment. But, if there are over-allocated rivers, those infrastructure connections only make sense when transactions are likely to happen. In Catalonia and Spain, transactions are not likely to happen.

Some high-ranked officials of the Catalan Water Agency half-heartedly tried to dress up this Ebro transfer as a scheme to buy irrigators rights, as they had done when arguing for the connection between Segre agricultural region farmers and urban districts.¹⁰⁸ Surprisingly, irrigators in the Ebro region did not agree to water exchanges, and instead they were willing to save water collectively and freely send it to the Barcelona's Metropolitan Area.¹⁰⁹ This evidences the lack of market culture for water. They probably feared that if

106. See CAL. WATER CODE §§ 1810-14.

107. Interview with Mónica Sastre, Attorney at Arifio Villar, Madrid, Spain (July 27, 2012).

108. Arnau Ugell, *Transvasament de la conca alta del Segre a l'Àrea Metropolitana de Barcelona* [Transfer from the Upper-Basin of the Segre River to the Barcelona's Metropolitan Area], OBSERVATORI DE PROJECTES I DEBATS TERRITORIALS A CATALUNYA (Dec. 31, 2008), http://territori.scot.cat/cat/notices/2008/12/transvasament_de_la_conca_alta_del_segre_a_l_Area_metropolitan_a_de_barcelona_2008_172.php.

109. See *id.* They might have fear the application of Article 65 of the CWA, which empowers the agency to review the licenses granted if it assesses that the holder needs less water to fulfill his needs. There is no clear protection against this article, but it might be implicit since it is expressly establish that water rights lease contracts (Article 69) will not affect the lapsing of the license (Article 66) which is triggered if the user if use is interrupted for three years in a row.

water was sold, one would assume they did not need it and, thus, their rights would be forfeited.

This fear is precisely the third problem that leases encounter. Like in California, water rights must be used in Spain; if they are not, they are subject to forfeiture. In Spain, the period of non-use is three years while in California it is five. Both jurisdictions also have provisions ensuring that water is used reasonably. In California, appropriative rights are subject to beneficial use requirements and in Spain, permits could be revised if the River Basin Authority (RBA) determined the same goal could be achieved with less water.¹¹⁰ The California Water Code has been amended several times to ensure that those transferring water are certain that their underlying right is not going to be affected.¹¹¹ Conversely, Spain has fallen short and has failed to enact any provision particularly tailored to calm those fears.

2. Water Exchange Centers

Water Exchange Centers (*centros de intercambio de derechos*) are structures inspired by California's experience in 1991,¹¹² and agencies play the role of match-maker. However, the scope of water banks in Spain is smaller, as it is a basin rather than the whole country. It would be similar to the water banks organized by local or regional organizations in the U.S. if it were not for the centralization effect: authorization by the central government cabinet is required before the River Basin Authority establishes them. Such an authorization can be quite broad. For instance, the 2004 authorization permitted establishment of *centros de intercambio de derechos* in the Guadiana, Segura, and Júcar water basins.¹¹³ This authorization was given in October 2004, a rainy month ahead of the drought to come.

110. See CWA art. 65.2.

111. Since 1979, water conserved was not subject to forfeiture according to CAL. WATER CODE § 1011. In 1982, it was made clear that under this section water not used or conserved could be transferred without fear of forfeiture; it is considered that transferred water complies with the beneficial use requirement. However, those provisions were not enough. During the period this dissertation focuses on, the CAL. WATER CODE was amended several times to ensure that in the doctrine of beneficial use, conserved water or water unused as a result of fallowing for a transfer was not going to be considered waste and therefore the rights of the transferor could not be curtailed. In 1991, CAL. WATER CODE § 484(a) was introduced, which ensures that the water that the transferor would have used or stored could be transferable without being detrimental to him. Then in 1999, more provisions trying to increase certainty were enacted. The 1999 amendments emphasized that neither a transfer nor a proposed transfer could trigger any water rights review and that the only limitations which could be imposed must be a consequence of the transaction and tied to it. See § 1014. In fact, § 1011 could be seen as redundant because the 1999 reform also shifted the focus from the transferor to the transferee. So far as the transferee puts the water to beneficial use, it should not negatively affect the transferor's right. If the transferee violates the beneficial use requirement, the water reverts back to the transferor. See § 1015.

112. Guía Nueva Cultura del Agua, "*Mercados públicos*" *para gestionar la escasez*, <http://www.fnca.eu/guia-nueva-cultura-del-agua/la-economia-del-agua/mercados-publicos-para-gestionar-la-escasez> (last visited Feb. 28, 2016); Antonio Embid Irujo, *Una nueva forma de asignación de recursos: El mercado del agua* [A New Form of Resource Allocation: The Water Market], *Ingeniería y Territorio*, REVISTA DEL COLEGIO DE INGENIEROS DE CAMINOS, CANALES Y PUERTOS 38, 38 (2000).

113. Acuerdo del Consejo de Ministros (Cabinet Decision) (Oct. 15, 2004) (authorized the establishment of "centros de intercambio de derechos" in the Guadiana, Segura, and Júcar water basins), <http://www.lamoncloa.gob.es/consejodeministros/referencias/Paginas/2004/c1510040.aspx#DerechosAgua>. The nine interregional RBAs are Miño-Sil, Cantábrico, Duero, Ebro, Guadalquivir, Guadiana, Júcar, Segura, and Tagus; and seven regional ones: Andalusia-Atlantic, Andalusia-Mediterranean, Balearic Islands, Basque Country, Canary Islands, Catalonia, and Galicia. The interregional ones govern river basins shared among different regions.

This prior authorization can entail a delay in any reaction to a drought unless the authorization is granted in advance, as was the case for the three basins mentioned in 2004. It must be noted that it did not apply to all the basins. The time taken to overcome these bureaucratic hurdles may be precious time wasted in other cases. The nested nature—that is the decision to establish a bank and the authorization being decided at two different levels—and lack of permanency slow down the reaction to a crisis. For example, in the Segura Basin, it took more than two years from the announcement to the actual implementation of the center.¹¹⁴ For the internal river basins in Catalonia, the Catalan Parliament included water exchange centers in the emergency decrees as a possibility.¹¹⁵ In the end, political will never materialized to bring them about and the Catalan Water Agency never implemented the exchange centers.

Currently, in the different Spanish Drought Plans passed since 2007, several *Confederaciones Hidrográficas* include the exchange centers as a measure triggered by certain drought scenarios.¹¹⁶ However, as stated, they cannot be automatically triggered, and this ends up being just programmatic: it is required that the central government gives them the green light beforehand.

As the 1991, the 1992, or the 1994 California Water Banks and Spanish *centros de intercambio* are not permanent, RBAs are allowed to set up Water Exchange Centers in exceptional circumstances: overexploitation of aquifers, severe drought, and instances where the uses should be limited to guaranteeing a rational exploitation of the resource.¹¹⁷ The centers last only until the crisis is over. However, the authorization requirement previously discussed runs counter to the need to respond quickly to crisis. The 1991 Water Bank was organized in record time: California Governor Pete Wilson signed an Executive Order on February 1, 1991, establishing the Drought Action Team, which recommended setting up a Bank on its report issued February 15, 1991,¹¹⁸ and the Bank was working in less than one hundred days thanks to the quick response of the state government.¹¹⁹

Delay in response to a crisis is also caused by water exchange centers following Spanish public procurement regulations, which impose several formal requirements to ensure that the process is competitive.¹²⁰ Private parties have to adapt to the requirements of

114. Javier Calatrava Leyva, *Mercados y bancos de agua en España: Legislación y experiencias vigentes* [Water Markets and Water Banks in Spain: Legislation and Experiences], in *AGRICULTURA FAMILIAR EN ESPAÑA* 99, 103 (2006), http://www.upa.es/anuario_2006/pag_099-105_calatrava.pdf.

115. 3d Additional Provision Decret 84/2007, de 3 d'abril, d'adopció de mesures excepcionals i d'emergència en relació amb la utilització dels recursos hídrics, DOGC 4860, (Apr. 12, 2007) (Catalan Decree adopting exceptional and emergency measures in relation to the use of water resources).

116. See e.g., Executive Report Drought Preparedness Plan Tajo River Basin 97 (2007) (mentioning that more water leases might be expected).

117. See CWA art. 71. The exceptional situations are described in CWA articles 55, 56, and 58.

118. *Id.*

119. THE 1991 DROUGHT WATER BANK 1, 19 (1992), http://www.water.ca.gov/watertransfers/docs/10_1991-water_bank.pdf.

120. The general regulation of public procurement is established by the following Act: Real Decreto Legislativo 3/2011, de 14 de noviembre, por el que se aprueba el texto refundido de la Ley de Contratos del Sector Público (B.O.E. 2011/276). From 2007 on, the regulation could be found in Ley 30/2007, de 30 de octubre, de Contratos del Sector Público (B.O.E. 2007/271) and from 2000 to 2007 in Texto Refundido de la Ley de Contratos de las Administraciones Públicas, aprobado por el Real Decreto Legislativo 2/2000, de 16 de junio (B.O.E. 2000/241). The different regulations are increasingly influenced by the European Union requirements and despite the fact that they may differ in the details, the principles are the same. Basically, the principles of transparency and competition must be carefully respected to prevent favoring certain companies with taxpayer money or which

the tender, which includes, among other things, precise terms and a secret offer. This may reduce the pool of potential sellers. Additionally, it curtails the administrative discretion, like any other public procurement contract, in order to ensure that there are no corrupt practices. These requirements do not seem to target the needs of water management since they slow down the process and, in general, involve very little danger of favorable treatment because they would consist of buying or leasing atomized water rights to resell or release them. These constraints also curtail the flexibility of the administration since the time period between the offer publication, the reception of the tenders, and the resolution is quite long. In any case, the requirements imply that these banks have to operate in batches and the time period between offers and adjudications is too long to properly respond to a crisis. For example, in the Jucar Basin, an offer was published in the *Official Gazette* on December 2006, and the decision about which rights were leased was published on July 2007.¹²¹ Water banks are theoretically closer to spot markets; Spanish *centros de intercambio* are far from being so. Parties may not want such a slow process even if they could benefit from the guarantee. California water banks, like Spanish ones, fixed the price while decreasing transaction costs by providing sample contracts. In 1991 only one option was offered, while in 1992 there was a portfolio of contracts, which allowed a certain tailoring for the different transactions.¹²²

Spanish *centros de intercambio* have never worked in real markets. Instead, they have been used as mechanisms for CHs to purchase water for the environment, much like the CALFED Environmental Water Account.¹²³ One of them, in the Guadiana basin, ended up reallocating the majority of the water rights to consumptive uses but not through market transactions.¹²⁴ In 1991, the California water bank acquired water for instream uses. The bank's main purpose was not environmental protection but the environment benefited because sales ended up being fewer than purchases; less users decided to buy water from the bank after the spring rains.¹²⁵ Additionally, since 1991, in California, existing right-holders could transfer water to in-stream uses,¹²⁶ a possibility that does not exist in Spain.

One commonality between these two jurisdictions concerning water banks is that factors other than market mechanisms (e.g., demand) are sometimes pursued to determine reallocation. In the Jucar basin, externalities affecting the environment or third parties are mitigated since the amount sold will be reduced to a certain percentage to be fixed in order

will not provide proper public services. This means that the RBA has to issue a Public Offer of Acquisition calling for applications of those who want to lease their water and fulfill the requirements set forth in the offer. Those applications must be hand in before a deadline in secret envelopes. They are reviewed all at once and then the resolution of which ones will be. After that, the resolution of which ones will be bought will be publicized.

121. B.O.E. 165/2007. There was an extension to present more offer of rights to be acquired.

122. Morris Israel & Jay R. Lund, RECENT CALIFORNIA WATER TRANSFERS : EMERGING OPTIONS FOR WATER MANAGEMENT 32, 63 (US ARMY CORPS OF ENGINEERS (1992)).

123. "The CALFED Bay-Delta Program is a unique collaboration among 25 state and federal agencies that came together with a mission: to improve California's water supply and the ecological health of the San Francisco Bay/Sacramento-San Joaquin River Delta." *About*, CALFED, <http://calwater.ca.gov/calfed/about/> (last visited on Mar. 27, 2016).

124. ROSA REQUENA, CENTRO DE INTERCAMBIOS EN EL ALTO GUADIANA [EXCHANGE CENTER IN ALTO GUADIANA] 23 (2011), <http://www.ceigram.upm.es/sfs/otros/ceigram/Contenidos%20Investigaci%C3%B3n/contenido%20seminarios%20cientificos/CENTROS%20DE%20INTERCAMBIO%20MADRID%2027062011.ppt>.

125. Howitt et al., *supra* note 104, at 74 (report that 810,713.19 acre-ft were bought and 405,356.59 acre-ft round numbers in cubic meters).

126. CAL. WATER CODE § 1707.

to contribute to the recovery and maintenance of the water.¹²⁷ In California, 1991 Water Bank buyers had to demonstrate that they were using current available water supplies at their maximum, implementing appropriate conservation practices.¹²⁸ Markets are supposed to encourage efficient use on both sides—buyers and sellers—because water will be properly priced and, thus, buyers would implement conservation measures if it is more efficient to do so. However, California's rules impose conservation requirements, which means that buyers may have had to implement water saving measures even if they were more expensive than actually buying water.

As the previous explanation has exposed, water markets in Spain, and consequently in Catalonia, have design flaws, and water agencies have lacked the will to make markets thrive. The following table summarizes those flaws and how California's experience has, if at all, addressed the same issues. Most of the design problems in the Spanish water market framework are not present in the California system, as the Golden State has done a better job with implementation. Nevertheless, lessons can be drawn for other water markets and for all U.S. Western states regarding the ability of certain drought emergency decisions to thwart or preempt markets, as the next section further discusses.

Govern- mental role	Shortcoming in Spanish Water Markets	Potential solution adopted in California
Definition of property rights: Tradability	Water leases can only happen between those already holding permits. Trades have to respect the Ranking of uses.	Trades can happen between a willing buyer and a willing seller provided there are not harmful effects for third parties
Definition of property rights: Certainty	Users were not given proper assurances that the underlying water right would not be reviewed by the administration after entering on a transaction because they fear that leasing the water may show that they do not need it.	Provisions were enacted to ensure that users are not subject to forfeiture for non-use when entering into water transactions. Also, several provisions ensure that the water sold still fulfills the requirements to be considered as put to beneficial use.
Externalities: Review procedure for transactions	Streamlined procedure in the books. Procedural regulations lack guidance	Cumbersome procedure differentiating between short term and long term transactions. Most of the transactions are also subject to the California Environmental Quality Act. However, the agencies offer plenty of guidance on how to deal with the procedure.

127. Yagüe-Córdova, *supra* note 97, at 10.

128. Israel & Lund, *supra* note 122, at 6.

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Natural monopoly: Infrastructure	No clear common carrier duty assigned. Separate authorization when the owner of the transaction is a public agency. When the owner is a private party, the parties need to bargain.	Infrastructure is open to third parties up to 70% of unused capacity. Nonetheless, California also has the same problem regarding the authorization procedure: there are separate reviews for infrastructure use and for the transaction.
Market maker: Water banks	Water banks require several steps to be set up. Those steps imply decisions by different levels of government that causes delay and prevents timely response to droughts. Water banks are subject to public procurement regulations which do not suit the type of small transactions occurring.	Water banks were a game changer. They helped to internalize the idea that water markets are a permanent tool for water management. Not only water banks themselves decrease transaction costs because the administration is the broker, but California water agencies learned after 1991 that offering forms and information further enhanced the performance of water markets.

V. CONCLUSION

This article provides a novel descriptive account of the geographic, political, governance, and institutional features related to water in Catalonia (Spain) in order to understand the options available to regions that face structural scarcity and periodical droughts. Accordingly, it further presents a case study of the 2007-2008 drought crises in Catalonia, which called into question the appropriateness of an administrative management system in controlling a scare resource. This article has analyzed the solutions that address supply and demand, which have been adopted in Catalonia, with special emphasis on one solution that did not play a role in the management of the drought crisis: water markets.

Spanish water markets presented a lot of design flaws, which prevented them from taking off as water management tools. Public agencies did not embrace them as tools to solve water misallocation and did not build expertise on how to oversee them. This, coupled with the lack of market culture (i.e. the reluctance that water users feel towards transferring their water), caused markets to become inactive, and prevented users from contributing to the mitigation of structural water scarcity. In addition, it is expected for water

markets to be more active when there is a drought, but that was not the case during the 2007-2008 droughts, due to management through emergency measures.

In particular, in Catalonia, water markets were not welcomed, not even in the event of a crisis. To exactly understand what difference markets could make within an administrative regime, it is interesting to refer back to the management of the 2007-2008 drought in Barcelona. Household use was not curtailed in the city, but it could have been. It was nonetheless curtailed in some suburban areas where it was forbidden to irrigate lawns and fill pools. Transactions between agricultural producers and the cities could have prevented them. But the decrees mostly shielded urban areas and, thus, urban water suppliers did not have incentives to enter into water leases to mitigate the effects of the crisis.

Even if private parties did not shield themselves from a drought by entering into transactions before the crisis, water contracts could have corrected the restriction decisions made by the administrative agencies (who, during a drought, decide which types of uses should get water and which should not) without taking into account the specific marginal value. But, most cuts were suffered by agricultural areas, and the anticipation of such discretionary restrictions may have cast uncertainty about who would get water. Thus, transactions were prevented in advance. In addition, as section IV.C has analyzed, the Spanish regulation of water markets also prevents private parties from responding quickly to a crisis.

The Catalan Emergency Decree's provision establishing water banks was never implemented. Instead, mandated transfers seemed to be the default rule. The transfers between the Ebro or Segre and the Barcelona Metropolitan area, sponsored by Spanish and Catalan authorities respectively, were framed by certain officials as potential exchange frameworks, but such an approach was not accepted. Instead, it was pretended that there was surplus water, and transfers were mandated. However, transfers were not real solutions because the Ebro and Segre rivers, despite not being in an acute state, did not have enough water. As these rivers suffer from a Mediterranean climate similar to the Internal Basins, there was not surplus water in the long term. If a market would have been established, water that would have been used anyway that could have transfer from low value users to cities, thus alleviating the problem. Infrastructure was discussed to allow the mandated transfers, which could have also provided the channels allowing for the operation of water banks or private contracts. Furthermore, in the long run, infrastructure use is relatively inexpensive, and temporary or permanent water contracts could have taken place allowing agents to permanently ensure their supplies or plans for potential water shortages. However, the infrastructure was not built. Mandated transfers have a history of discontent which made them highly unpopular even amidst a drought and water markets had not been embraced as a tool of water management, neither by private users nor by public agencies.

The unplanned administrative response to drought crisis negatively affects the role that water markets may have in the future, under both normal and drought conditions, because it creates uncertainty about who will receive water. This same problem can occur in any Western state where agencies undertake the same use restrictions. In its 2014 emergency measures, California, which already has a better water market design (even though

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it recently adopted cuts), included provisions aimed at reducing the costs of water transactions by streamlining the administrative review procedure.¹²⁹ Also, in contrast with the ineffective provisions in Catalonia's emergency decrees about water banks, water banks have played a great role in California. While under Spanish regulations procedural requirements make those banks unsuited to fulfill their purported goal (i.e. mitigate drought scenarios), water banks in California have been an example of quick response and have improved in every water shortage experience.

Beginning in 2007, Spanish basins started designing and enacting Drought Preparedness Plans. Thus, the future will prove whether predictability is achieved with those documents or whether uncertainty will still exist because emergency measures will still rule during drought crisis. Some of those plans have included water transactions and water banks among their emergency measures. Perhaps Spain learned the lesson, but in this learning process fifteen years of experience on how to better articulate water markets has been lost.

Regarding drought planning, the situation west of the 100th meridian is unequal. States such as Nevada, California, or New Mexico extensively discuss drought preparedness in their water plans. Meanwhile, others, such as Utah or Idaho, have little to no discussion of drought preparedness in their plans. Furthermore, Colorado and a few other states have specific plans to deal with droughts. Regardless of a state's plan, emergency measures are likely to play a role. If measures are enacted beyond what the Drought Preparedness Plan established in Spain, they should be crafted in such a way that enhances the role that water markets could play.

129. Governor Jerry Brown of California included provisions in his decrees to reduce transaction costs to enlist water market transactions in the state's strategy to mitigate the effects of the drought even though water for urban consumers was ensured. Among other pro-transfer measures adopted, the package streamlined the review procedure by exempting water transfers from California Environmental Quality Act Review. The measure has been criticized by environmentalists and, rightly so, because it tries to enhance water transactions lowering the barriers that protect the environment. The haste of the measure may explain this reaction. Perhaps the measures to enhance markets should be thought through and enacted with a long-term view while ensuring a stable framework that deals with situations of low availability of water.